

CLAIMS

What is claimed is:

1 1. A method of producing a tracking error signal as a difference signal of optical
2 detection signals generated by more than two optical detectors positioned along a line diagonal
3 to a track center, the method comprising:

4 binarizing each of the outputs of the optical detectors;

5 phase locking to generate respective clock signals synchronized with each of the
6 binarized outputs;

7 detecting a phase difference between the synchronized clock signals; and

8 low-pass filtering the detected phase difference to output the tracking error signal.

9 2. A tracking error detecting apparatus for producing a tracking error signal as a
10 difference signal of optical detection signals generated by more than two optical detectors
11 positioned along a line diagonal line to a track center, the apparatus comprising:

12 binarizers which binarize each of the optical detection signals;

13 phase locked loops which generate clock signals synchronized with each of the outputs
14 of the binarizers;

15 a phase difference detector which detects a phase difference between the synchronized
16 clock signals output from the phase locked loops; and

17 a low-pass filter which filters the output of the phase difference detector to output the
18 result as the tracking error signal.

19 3. The tracking error detecting apparatus as claimed in claim 2, further comprising
20 equalizers which reinforce the high-frequency components of the optical detection signals and
21 output the results to the binarizers.

1 4. The tracking error detecting apparatus as claimed in claim 3, wherein the
2 equalizers remove low-frequency components of a spectrum from the optical detection signals,
3 according to a recording modulation method.

1 5. The tracking error detecting apparatus as claimed in claim 2, wherein a clock
2 signal provided to the phase locked loops is a channel clock signal.

1 6. The tracking error detecting apparatus as claimed in claim 5, further comprising
2 a frequency divider which divides the frequency of the channel clock signal by n (where
3 $n=2,3,4,\dots$) to output the result to the phase locked loops when a phase of an output signal is
4 inverted.

1 7. The tracking error detecting apparatus as claimed in claim 2, wherein the phase
2 difference detector generates a first phase difference signal indicating that a first synchronized
3 clock signal output from the phase locked loops leads a second synchronized clock signal
4 output from the phase locked loops, and a second phase difference signal indicating that the
5 second synchronized clock signal leads the first synchronized clock signal, and

6 wherein the low-pass filters include first and second low-pass filters which filter the
7 first and second phase difference signals, respectively, and

8 the tracking error detecting apparatus, further comprises a differential amplifier which
9 generates a tracking error signal corresponding to a difference signal of the outputs of the first
10 and second low-pass filters.

1 8. A tracking error detecting apparatus for producing a tracking error signal as a
2 difference signal of optical detection signals generated by two optical detectors disposed at the
3 outside of the track center of a three-section optical detection unit, the apparatus comprising:

4 binarizers which binarize each of the optical detection signals;

5 a phase difference detector which detects a phase difference between the binarized
6 signals; and

7 a low-pass filter which filters the output of the phase difference detector to output the
8 result as the tracking error signal.

1 9. The tracking error detecting apparatus as claimed in claim 8, further comprising
2 phase locked loops which couple the binarizers and the phase difference detector, wherein the
3 phase locked loops generate clock signals synchronized with each of the outputs of the
4 binarizers, to output synchronized signals to the phase difference detector,
5 wherein the phase difference detector detects a phase difference between the
6 synchronized signals output from the phase locked loops.

1 10. An apparatus for providing a tracking error signal for an optical disk recording
2 track, comprising:

3 first and second optical detectors which generate first and second electrical signals,
4 respectively;

5 a circuit which binarizes the first and second electrical signals and phase locks each of
6 the binarized signals to output first and second clock signals synchronized with the first and
7 second binarized signals; and

8 a phase detector which compares a phase of the first synchronized clock signal with a
9 phase of the second synchronized clock signal to generate the tracking error signal.

1 11. The apparatus as claimed in claim 10, wherein said first and second optical
2 detectors are on a line transverse to the optical disk recording track.

1 12. The apparatus as claimed in claim 10, wherein said first and second optical
2 detectors are on a line diagonal to the optical disk recording track.

1 13. The apparatus as claimed in claim 10, further comprising first and second
2 equalizers which increase a high frequency component of the first and second electrical signals
3 prior to binarizing said first and second electrical signals, respectively.

1 14. The apparatus as claimed in claim 13, wherein each said equalizer includes a
2 differentiator which operates on the respective electrical signal.

1 15. The apparatus as claimed in claim 14, wherein each said differentiator operates on
2 frequencies of the respective electrical signal which are less than a first value.

1 16. The apparatus as claimed in claim 14, wherein each said differentiator operates on
2 frequencies of the respective electrical signal which are greater than a first value.

1 17. An apparatus for providing a tracking error signal for an optical disk recording
2 track, comprising:

3 a plurality of optical detectors each of which generates an electrical signal,

4 a matrix circuit which selects and adds said electrical signals in pairs to output at least
5 one matrixed signal, each said pair corresponding to optical information detected along a line
6 diagonal to said recording track;

7 a circuit which binarizes each matrixed signal and performs a phase lock operation on
8 each matrixed signal to output clock signals synchronized with the respective matrixed signals;
9 and

10 a phase detector which compares a phase of one of said synchronized clock signals with
11 a phase of another of said synchronized clock signals to generate the tracking error signal.

1 18. The apparatus as claimed in claim 17, further comprising first and second
2 equalizers which increase a high frequency component of respective ones of the matrixed
3 signals matrixed signals prior to respectively binarizing said matrixed signals.

1 19. The apparatus as claimed in claim 18, wherein each said equalizer includes a
2 differentiator which operates on the respective matrixed signal.

1 20. The apparatus as claimed in claim 19, wherein each said differentiator operates on
2 frequencies of the respective matrixed signal which are less than a predetermined value.

1 21. The apparatus as claimed in claim 14, wherein each said differentiator operates on
2 frequencies of the respective matrixed signal which are greater than a predetermined value.

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